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THE INFORMATION REVOLUTION:
SOME RECENT DEVELOPMENTS

Joe A. Gatner

Political and Social Affairs Division
Research Branch
Ottawa

September 1985



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BACKGROUND PAPER FOR PARLIAMENTARIANS

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THE INFORMATION REVOLUTION:
SOME RECENT DEVELOPMENTS

The mixture of microchip technology and telecommunications is changing our lives in many ways it can hurt us or help us depending on how it is used ...(1)

... The diffusion of informatics could produce cultural effects that are not comparable ... to those produced by other crucial and revolutionary technological events, such as the invention of the printing press, of steam power, or even that complex and fascinating phenomenon, automation.(2)

INTRODUCTION

These quotations give two somewhat conflicting and unnerving views of the current information revolution. The literature of today on the subject employs the two terms "telematics" and "informatics" to describe the processes that underlie this current phenomenon. Used almost synonymously, they denote the melding of modern communications technology with the application of the computer microchip to process and transmit information at one quarter of a billion to one billion operations per second, the latter being the range of power anticipated in the next decade. Such transmission can be effected from one part of the country to another, or one part of the globe to another without any significant difference of content or method.

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- (1) The Royal Bank of Canada, The Royal Bank Letter, Vol. 66, No. 2, March/April 1985.
 - (2) Massimo Negrotti, "Cultural Dynamics in the Diffusion of Informatics," Futures, Butterworth and Co., February 1984, p. 39.

"Telematics" came into being in the report entitled, L'informatisation de la société, which was prepared for the President of France in 1978 by Simon Nora and Alain Minc.⁽¹⁾ "Informatics", more commonly used in the anglophone world today, appears to have been first used by the British authority on the subject, Anthony Smith, in his book, The Geopolitics of Information, published in 1980.⁽²⁾ These two words describe the central processes involved in the linkage of the technologies of the computer and modern high speed telecommunications.

There is a growing consensus that the ubiquitous combination of the computer and mass communication has created a powerful new medium that may transform the whole of our traditional concepts about the value of information and the nature of the interaction between individuals and the world in which we live. With such astounding predictions the impact of this technology could be quite beyond anything currently foreseen.

Furthermore, it is envisaged that the cost of the hardware involved, when amortized over the life of a system, is virtually non-existent and it is anticipated that engineers will be designing new products under this assumption. It is already apparent that the continuing costs will be for the software, i.e. programs that order the computer to do specific tasks. With the introduction of more efficient "wired bandwidth communication", the costs of the transmission of information will essentially also be zero.

The impact of this combined technology can already be appreciated by looking at achievements of the modern telecommunications satellite. In many instances this has made communication possible where previously it was impossible or at least extremely difficult. Furthermore, the telecommunications satellite knows no national boundaries; it deals with the world's nations as if they were one. Indeed, satellite communication

(1) S. Nora and A. Minc, L'informatisation de la société, rapport à M. le Président de la République, Paris, La documentation française, janvier 1978.

(2) A. Smith, The Geopolitics of Information, How Western Culture Dominates the World, Oxford University Press, New York, 1980, p. 126 ff.

has captured the imagination of people throughout the world. It is the satellite's tremendous electronic transmission capabilities, when connected with the computer microchip, that can encourage hope for human progress or fear for inhuman consequences. Like the satellite, the computer, when connected with the emerging international communications network, knows no national boundaries. In fact, today it is relatively easy to produce information in one part of the world and then market it in another part.

As a consequence, more and more nations have begun to see information as a new resource and informatics as a systematic way of applying information to political, economic and social problems. Rather interestingly, Daniel Bell, of the "post-industrial society" fame, in his introduction to the English translation of the Nora/Minc report suggests that "'computerization of society' will shape, allow, facilitate, determine -- which verb will be the operative one depends on our consciousness and public policy -- an extraordinary transformation perhaps even greater in its impact than the industrial revolution of the previous century."(1)

In the United States information is viewed as a necessary resource for technological and economic growth, as well as a means of efficient management of business enterprises and personal affairs. The French see information, along with its related equipment and systems, of prime importance to their economic growth. Brazilian industrial policy calls for the absorption of such technology into its future economic development. Indonesia, Thailand, the Philippines, India and the new nations of the Pacific Basin, as well as Japan, are all searching for the means to expand their communications and computing capabilities.

The global reality of telecommunications and information transfer is part of the daily activity of the multinational firms. Satellites have already proven to be of enormous economic benefit to those who have been able to utilize their capability. For instance, oil producers use them to monitor their tankers, i.e., to indicate when they arrive in port and what special problems must be dealt with in order to allocate the

(1) S. Nora and A. Minc, The Computerization of Society, A Report to the President of France, The MIT Press, English translation, 1980, p. x.

product along their international network. International satellite communications have been a boon for the airline industries as well.

The problems that ensue from the rapid development of computer information processing undoubtedly require attention without delay. One of the immediate consequences is that a modern information communications network offers the opportunity to replace people with bits of information travelling at the speed of light. Among other things, this has created the prospect of mass unemployment. The automatic adjusting of account balances in business offices and maintenance of inventory at the local grocery supermarket are two examples. Furthermore, because computer communication information networks know no national boundaries, one immediate problem is the transborder flow of data. Another problem is the preservation of individual privacy. This is further complicated by the incompatibility of laws in different countries. In fact, the privacy laws of one country may be in direct conflict with those of another. Indeed, these may be only the first of many other such conflicts of law that will come to the fore with the development of the global information society.

INFORMATION PROCESSING TECHNOLOGY

The heart of the information infrastructure is the multi-capable computer. A perfectly general purpose machine, it can calculate a payroll, control the temperature of a house, play "Starwars", or process memoranda. In fact, new uses for the computers, or microprocessors as they are sometimes called when they are designed and programmed for specific purposes, are being found almost daily as developments in microelectronics are drastically reducing their costs and physical size.

Transmission and carrier technologies are rapidly being upgraded and improved ways are now being found to interconnect them. Such networks will eventually provide inexpensive and reliable global movement of

information of all kinds. Communication satellites will play an increasingly important role in communications as their launch cost and that of their earth-based receivers continue to decrease. Laser and fibre optics will exploit the higher bandwidth of lightwaves, which allows them to carry much more information. As Dr. Arthur J. Cordell of the Science Council of Canada states, in his latest publication The Uneasy 'Eighties, "Theoretically, a single lightwave could accommodate every telephone message, radio broadcast and television program in North America simultaneously." More specifically, it is estimated that 10,000 simultaneous telephone conversations could be carried through a single pair of optical fibres.⁽¹⁾ In Saskatchewan, Northern Telecom has just completed the outfitting of the largest fibre optics system in the world.

While communications satellites and fibre optics are among the most recent contributors to the emerging information infrastructure, co-axial copper cable has been in place in Canada for several decades. Cable television has become a primarily urban phenomenon with penetration rates of 80% to 90% in some metropolitan areas in Canada. Furthermore, the QUBE system of Columbus, Ohio, developed by Warner Cable Company, has its counterpart in Canadian Cable Systems in London, Ontario. With this technology the viewer, through the employment of a key-pad, can signify agreement or disagreement with what he is watching and register his pleasure or displeasure with a performer on a particular television program. This will soon be followed by teleshopping and televoting which is possible with the same "interactive" cable system. Such "two-way broadband information services" will become a common feature in homes, offices, etc. throughout Canada, predicts Dr. Cordell.⁽²⁾

Similar advances have been recorded in computer evolution as well. As more and more computing power is concentrated in a single silicon

(1) A.J. Cordell, The Uneasy 'Eighties, The Transition to an Information Society, Background Study 53, Science Council of Canada, Canadian Government Publishing Centre, Hull, P.Q., March 1985, p. 17-18.

(2) Ibid., p. 18-21.

chip, the computer becomes faster, cheaper and more powerful, as well as more compact. The result is that many problems that once lay outside the capacity of a computer memory or took too much time to solve have now become soluble. Furthermore, the marriage between telecommunications and the computer has caused a kind of information explosion. Computers multiply the amount of information available by mating different sets of facts to breed new ones. Their capacity for comparing and combining disparate pieces of information has opened new horizons for research into any number of subjects. In the words of the author of the The Royal Bank Letter, "the question at the heart of all scientific inquiry -- 'what if?' -- can be endlessly explored by matching facts and figures with one another until a proposition is proved or otherwise."⁽¹⁾

In addition, Computer Aided Design (CAD) and Computer Aided Manufacture (CAM), while reducing manpower requirements and increasing productivity, will change the nature of industrial production itself. These applications permit abbreviated design and production times that allow small establishments to compete with big ones in many instances. Through a process called Flexible Manufacturing Systems (FMS),⁽²⁾ they can produce customized products in short runs without appreciably adding to the costs per unit. The recurring notices in the daily newspaper of beneficial breakthroughs in medicine against one disease or another are also examples of the scientific use of the computer.

The range of impact of this new technology on the economy, society and politics is difficult to predict, except that few areas will go unaffected. Two Italian scholars, Umberto Colombo and Giuseppe Lanza-vecchia, of the Italian Atomic Energy Commission, in a paper before the Conference on the Information Society held in London, England in January 1982, contended that the informatics revolution really has just begun. According to them, the range of information technology is so vast and

(1) The Royal Bank Letter (1985), p. 2.

(2) Cordell (1985), p. 28-29.

adaptable, as well as beneficial, that it can play a role in all of man's activities.(1)

They predict there will be even more extraordinary advances with the arrival of biological information systems, "based on transmitters and receivers, storers and information vehicles of a molecular or ionic nature," also described as the "molecular" or sixth generation computer.(2) Such systems, they say, are particularly well suited to interact with man, using all his senses. Although slower than the emerging telematic systems, the quantity of information biological systems can transmit with even a single molecule is substantially greater. Consequently, they point out, it is as yet too difficult to evaluate their potential as well as the extent of their impact. Nevertheless, judging by the enormous progress in biological science and biotechnology, this process is much nearer than it may appear.(3)

In the light of the evolution and progression of these technologies it seems that man is left without any alternative but to focus his best efforts on the consequences that will flow from such developments. In this regard, Dr. Cordell warns that the work required from society to grapple with this new phenomenon should begin now. He says:

The rate and magnitude of change are rapidly outpacing the complex of theories -- economic, social, and philosophical -- on which public and private decisions are based. To the extent that we continue to view the world from the perspective of an earlier, vanishing age, we will continue to misunderstand the developments surrounding the transition to an information society, be unable to realize the full economic and social potential of this revolutionary technology, and risk making some very serious mistakes as reality and the theories we use to interpret it continue to diverge.(4)

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- (1) V. Colombo and G. Lanzavecchia, "The Transition to an Information Society: How Do We Manage the Change? What can R&D contribute", Conference on Information Society, North-Holland Publishing Company, Amsterdam, New York, Oxford, 1982, p. 21 and 26.
 - (2) Cordell (1985), p. 132.
 - (3) Ibid., p. 28.
 - (4) Ibid., p. 136.

DATA BANKS

In the emerging information society data banks or data bases of all kinds will be accessible quickly and cheaply to most. The social and industrial impact of large-scale information systems will be particularly evident from the proliferation of such data banks. It is predicted that the advent of large scale data banks will undoubtedly have far-reaching effects.

Anthony Smith in his book, Goodbye Gutenberg, predicts that the proliferation of data banks will likely change the function of the daily newspaper. The newspaper might embark on providing more general and background news than it generally carries today, while at the same time using its computer electronics to prepare packets of specific information for small groups of readers scattered across its distribution area. This is possible because the computer can extract and prepare specific items as it is directed, and because today's computerized newspaper now accumulates in its morgue about ten times as much material as it publishes in a day.⁽¹⁾ That such a store of saleable information would be left to accumulate without being put to some profitable use is unthinkable in a highly competitive society.

A data bank or data base can be described as an organized group of files from which information and data can be retrieved. A data directory provides the dictionary to data files and is in fact part of the data base itself. Along with this there is a system of sophisticated hardware that controls the manipulation of the data base. Data bases play a major role in selecting and disseminating information which can be conveniently retrieved through a specific program. Unlike information processing, which performs processing in accordance with a given program and directions, information retrieval allows the user to obtain whatever data or information he needs. To accomplish this, a very large amount of information must be collected, entered into data bases and continuously updated as a matter of course.⁽²⁾

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- (1) A. Smith, Goodbye Gutenberg, The Newspaper Revolution of the 1980's, Oxford University Press, New York, 1980, p. 115-19 and 135 ff.
 - (2) H. Inose and J.R. Pierce, Information Technology and Civilization, W.H. Freeman and Co., New York, 1984, p. 83.

Bibliographic retrieval of scientific and technical information is a valuable service for professionals in carrying out their work. In fact, business users are now beginning to rely heavily on commercial credit information and market quotations for stocks, commodities and foreign exchanges from data bases. Data services for the users of home computers are also appearing. These can be provided over telephone lines by information vendors. Data bases can also provide seat reservations, telephone directory assistance, credit card verification and other services over telephone lines. In some instances, for example, the Automatic Teller Machines (ATM) employed by banking institutions, the response to a request for data is beginning to be supplied by computer-synthesized speech. Apparently telephone companies are now exploring the possibility of providing a retrieval service for their yellow pages. Some suggest if such a service is permitted by law significant changes in advertising and purchasing will undoubtedly transpire.⁽¹⁾

One of the largest data bases in the world is "Dialogue" which is operated by the Lockheed Aircraft Company, the world's largest arms dealer. People who fear the information society do not fail to make the connection between the two. Another well-known data base is Info Globe Canada, the very up-to-date textual data base of the Toronto Globe and Mail. In the United States, Newsearch provides a similar data base covering the New York Times, Christian Science Monitor, Wall Street Journal, and about one hundred popular periodicals like People, Time and Newsweek, etc.⁽²⁾ Indeed, the technology of the computer has made it possible to store the whole of the Library of Congress data by means of disk and other such devices in the space of a wall in a modern living room.

A major problem that arises with regard to the storage of vast amounts of data relates to the possible infringement on personal privacy. Dr. Cordell points out that, "With computer transactions, people leave an electronic trail that can be stored cheaply in perpetuity." By interconnecting several data banks (the practice is now being termed "computer-matching, cross matching or computer linkage") "information can

(1) Ibid., p. 83-84.

(2) CBC Radio Transcript, "Telematics," Ideas, 5-26 September 1984, p. 37.

be shared to prepare information profiles on individuals quickly and cheaply".(1)

In Canada, problems regarding the degree to which such information should be curtailed are beginning to raise a conflict between federal and provincial authorities. Furthermore, complaints that the government is misusing personal information are now investigated under the existing federal privacy legislation as a matter of course.(2)

DATA FLOW

Information from data banks can also be obtained and transmitted by means of teletex or videotex, the former being a one-way information flow service, while the latter is a two-way information flow. In the teletex system the material is mixed into a TV signal in such a way that a user with a key-pad can select the information to be displayed on the screen of a video display terminal (VDT). A videotex process, such as Canada's own Telidon, is a system where the transmission lines between the user and the computer can be the public telephone network, a cable TV system with two-way capabilities or hybrids, such as a one-way cable into a home with normal telephone link. Users are thus able to send as well as receive signals. It is envisaged that with videotex in place people will be able to learn, work and shop at home. Similarly, videotex along with the computer could act as a switchboard to store and forward messages from one user to another, along with telemonitoring for security and other purposes.(3)

One of the most difficult and intriguing problems associated with data and information retrieval is that of transborder data flow. Computer communications facilities provide an opportunity for individuals

(1) Cordell (1985), p. 75.

(2) Canada, Privacy Commissioner, Annual Report, 1984-85, Minister of Supply and Services Ottawa, 1985, p. 36.

(3) J. Tydeman, "Videotex: Ushering in the Electronic Household," The Futurist, February 1982.

and corporations to collect and retain data in computers located outside Canada's borders. Some data processing services, originating in such places as Houston, Dallas and Denver in the United States, have been provided to Canadian users. On the other hand, there are a number of companies in Canada who have undertaken to export Canadian-based computer services. Datacrown Incorporated has entered the United States to process data for U.S. clients. Others, including such companies as Fortrex, Dataline, Realtime Data Pro, have had various successes in their export activities.⁽¹⁾

Another problem comes from the dumping of the excess product into another country at below cost prices. A Swedish company has offered such services at discount rates to clients in the United States because, when Swedes stop work in their own country, Californians, for instance, are just beginning their day. With their computer capacity idle for the night, Swedish companies can do work for clients thousands of miles away. Similarly, in a global economy, information stored in one country can easily be sold abroad at prices that need not account for the initial costs of gathering and compiling. Admittedly, such problems might arise only in the short term but until internationally acceptable arrangements are in place such factors could present very important concerns for the people involved.

The transition to an information society could indeed create potential international conflict that will have to be controlled and diffused says Klaus W. Grewlich of the planning staff of the West German Foreign Office in Bonn. Referring to the OECD countries, he has suggested "Internationally recognized principles stipulating free access to data banks" in conjunction with suitable international consultation to defuse potential conflicts and avert damage in terms of foreign political relations in such matters as "copyright, computer crime and the difficult question of extra-territoriality."⁽²⁾

(1) J.C. Paradi, "What are the issues in transborder data flow?", Canadian Data Systems, Vol. 15, April 1983, p. 74.

(2) Klaus W. Grewlich, "Free Electronic Information and Data Flow?", Aussen Politik, No. 36, First Quarter 1985, p. 55 and 60-69.

COSTS, HARDWARE AND SOFTWARE

The degree to which telematics or informatics will permeate our society will have a strong relationship to their costs. These are being reduced by the continued reduction of the size of the hardware and accompanying innovation and efficiency. For instance, it has been estimated that by 1990, the cost of computer memory will be but a fraction of what it is today. Even today, costs of some computer chips have apparently dropped to below the one dollar level. It is interesting to note that the computer chip whose malfunction precipitated the false NORAD alarm on 3 June 1980, when the computer indicated a Soviet attack on North America, cost only 46 cents, according to a recent article in Equinox magazine.⁽¹⁾ The Science Council of Canada has predicted that the cost of computer memory, i.e., the capacity of the computer chip, in 1990 will be 1/400th of 1982 costs; a prediction likely to come true considering that the power of computers has increased 10,000 times since 1967 while the price of each unit of performance has decreased 100,000, times.⁽²⁾

The home computer, for which the standard size was approximately 64 kilobytes of Random Access Memory (RAM) only a year ago, is now rapidly going to 128, 256 and the 500 and 600 levels. Similarly, the speed of high-speed processors is expected to increase by a power of 10,000. Communications will cost between one third and one tenth of the 1980 rate by the turn of the century, say other experts. Most important will be the intelligent home terminal which by 1990 is expected to cost approximately \$300. Such a terminal will hook-up to the home cable and telephone and provide the whole host of services alluded to above. Education systems will

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- (1) B.D. Johnson, "The master minds, supercomputers: creating machines that may dictate tomorrow's wealth and power", Equinox, No. 22, July/August 1985, p. 89.
 - (2) Canada, Science Council, Planning Now for an Information Society, Tomorrow is Too Late, Minister of Supply and Services, Ottawa, 1982, p. 15.

become more prevalent as well and will make up a large share of the computer market in the future.(1)

While the commercial and industrial computer-based information systems have been evolving continuously over the last several decades, the most dramatic proliferation of information-based technology in the last five years has been in the personal computer industry. Methods of distribution are likewise changing. In North America the most recent entrants in this field are the established mass retailers, such as Sears, Eaton's, The Bay and, in the United States, J.C. Penney and Montgomery Ward. International Business Machines is leading the way and trying to reach new customers with its innovative products. It is joined by such other wellknown corporations as Tandy Corporation's Radio Shack, Digital Equipment Corporation and Xerox, which have begun to sell computer business equipment. Meanwhile, others like Control Data Corporation are focussing on selling business services in a store network.(2)

The dizzying speed at which the information revolution is engulfing our society becomes apparent when we are warned by such people as Dr. Cordell that existing computer-based hardware will become obsolete overnight. He points out that laser videodisk storage will shortly replace existing data storage methods at a fraction of today's costs. Voice processing, he says, which converts human speech into digital form for computer processing and vice versa, will increase dramatically during the second half of the current decade, as technology advances and its costs decline. Furthermore, the marriage of video-disk technology and micro computers is opening up other new industries. From this technology we can expect such diverse applications as shopping arcades, video-disk encyclopedias, full texts of selected articles on a myriad of subjects, etc.(3)

(1) W.G. Hutchison, "Business forum, will Canada profit from the dawning information age? Ottawa must seize the challenge soon," Canadian Business, No. 53, February 1980, p. 99.

(2) Cordell (1985), p. 68-69.

(3) Ibid., p. 69-71.

"The future belongs to software" is a slogan that is rapidly permeating the information revolution. Initially, hardware and software were bundled together in one package and sold to those organizations that could afford it. Today, however, the software industry is poised to overtake the computer hardware sector. As the price of computers falls, the industry will become dominated by what is becoming known as the "software and services sector" whose size has been doubling every three years, according to Marc Clifford, writing for the Financial World in January 1984. Software products allow users to perform such specific tasks as accounting while, in the business area, software vendors are providing programs on floppy disk and hard disk to banking and insurance institutions as well as to the health care, education and transportation areas.(1)

The development of new, more precise and varied software applications will continue to incur the major costs in the information industry's technological advances. Some authorities claim that improved performance and lower prices will increase demand, which will more than make up for the revenue lost from price cuts. Meanwhile, engineers will design new products under the assumption that the hardware is essentially free. Software design costs in turn will increasingly overtake those of new computer and communications devices.(2) There is a good chance, however, that the ultimate impact of the information revolution will not be determined by cost alone. Indeed the matter may be decided by its analogous effects in other areas.

THE SOCIAL AND CULTURAL IMPACT

It has been suggested that the information revolution could have its greatest impact from the social and cultural effects that might

(1) M. Clifford, "The future belongs to software", Financial World, No. 153, 25 January - 7 February 1984, p. 8 and 13.

(2) H.S. Dordick, "The Emerging World Information Business," Columbia Journal of World Business, No. 18, Spring 1983, p. 73.

accompany it. As already stated at the outset, some authorities on this subject contend that its sociocultural effects will be "unlike those accompanying the introduction of other revolutionary technology." Massimo Negrotti, Professor of Sociology of Knowledge at the University of Genoa, Italy, contends that the social diffusion of informatics is not comparable to those effects produced by other crucial and revolutionary technological events, such as the invention of the printing press, steam power or the earlier complex forms of automation. In framing his argument as a sociologist, he points out that sociology itself was born as a consequence of the Industrial Revolution. While admitting some fallacious predictions owing to the rapidity of change in the past, he contends "sociologists of knowledge should today frame the problem in terms of the cultural premises of informatics rather than in terms of its consequences ..."(1) i.e., social consequences can only be short-term in nature while cultural effects are long-term and more permanent and penetrating.

The "most crucial aspects are the nature and scope of human needs", he says, "in regard to data- or information-processing and, particularly, the dynamics of the mental procedures that man uses in carrying out these activities". While the logical problems involved "are, relatively speaking, traditional ones, computerization in fields such as education, the coming standardization of some aspects of artificial intelligence as well as the employment of expert systems, are completely different." These involve the very focus of human nature itself, or "at least a group of mental categories and activities that both remain almost totally unknown and that are also undoubtedly in their turn influenced by the totality of culture itself."(2)

Furthermore, Negrotti contends that the computerized hardware and software devices available today themselves "express some cultural conception of man." Without advocating that computers have the power of thinking, he nevertheless suggests that their programs and packages do

(1) Negrotti (1984), p. 39-40.

(2) Ibid.

reflect fragments of thought, ideas and attitudes. The fundamental difference between the classical technological products of the past and the computers of today is that the former largely satisfied psycho-physical needs, while the latter enable man to "amplify and express cultural dimensions that are the result of profoundly different histories and evolutionary paths of models of thinking, reasoning and inferring." (1)

Negrotti also contends that too many people consider computers only as devices for solving long-standing problems about human nature or as tools to simplify everyday life. He suggests that informatics is a science of man that is sometimes able to "simulate human behaviour, giving us useful hypotheses about what really happens in the human mind." (2) Moreover, he predicts, the range of information technologies is so vast and adaptable, as well as economically and organizationally advantageous that it will play a role in most of man's activities. Many services such as those of banks, newspapers, the tourism industry, advertising, marketing and transportation are now being organized around information technologies. It is highly likely that by the end of the century information technologies will have replaced most of the traditional technologies in the industrialized countries and to some extent also in the developing countries, in the opinion of Colombo and Lanzavecchia. (3)

Problems which the information society is likely to encounter are both dramatic and manifold. Among those foreseen by today's authorities on the subject are:

- a) the possibility of intervening in all economic and social activities;
- b) the enormous increase in productivity;
- c) the gradual elimination of blue collar workers;
- d) the obsolescence of the traditional goods and service producing sectors;

(1) Ibid., p. 40-41.

(2) Ibid., p. 46.

(3) Colombo and Lanzavecchia (1982), p. 21.

- e) the creation of new productive sectors;
- f) the possibility of radically modernizing other social and economic sectors;
- g) the progress towards soft-type technologies;
- h) the need for vast amounts of capital for new investments;
- i) the potential stimulus to the economy and the creation of wealth;
- j) the combined pressure towards a reduction in working hours to offset unemployment;
- k) the probable destruction of existing equilibria of established interests;
- l) the danger of regression for whoever cannot or will not use the new technologies;
- m) the danger that the economic and social progress of the Third World will again be postponed leading to further widening of the North-South gap;
- n) the uncertainty concerning the adaptability of individuals and social groups to new forms of organization and values;
- o) the possibility of resistance and social rebellion.

The social aspects of the information revolution are especially important because of the effect they will have upon human behaviour at the individual and group level. It has also been suggested that such consequences could prove even more counterproductive and destructive than the negative effects of forcibly holding these technologies in abeyance to forestall any possible chaos.⁽¹⁾

The social consequences of the new information technologies could, in fact, depend very largely on the speed of their introduction. It is well-known that very rapid automation of particular industries has often proved destructive to the communities where they were situated. As well as considerable redundancy, they had insufficient time to retrain people for

(1) Ibid., p. 28-29.

the new tasks or for alternative employment, or to develop the techniques of management to perform effectively under the radically changed circumstances. Some, however, suggest that this is unlikely to happen in the aggregate if for no other reason than the scarcity of the required capital to effect such changes at an accelerated rate.⁽¹⁾ Nevertheless, continuing obsolescence with the associated unemployment problems will continue as a concern of the information society, leading to a never-ending need for retraining and education.

An important aspect of the new information and communications techniques is that distance is annihilated. This can pave the way for all kinds of decentralization including the dispersion of points of power and decision-making and lead to new forms of control and government and permit decisions to be taken much nearer to those who enjoy or suffer their consequences. On the other hand, the same means could be used by unscrupulous or power-hungry political leaders to consolidate and augment the centralization of power.⁽²⁾

A further preoccupation, according to Alexander King, of the International Federation of Institutes of Advanced Study in Sweden, is related to the increased vulnerability of a society based on technological systems. Even today, he points out, "the smooth functioning of cities and societies depends on technical devices which are exceedingly sensitive to disruption, either to occasional malfunctioning or to sabotage As human activity becomes more deeply computerized, such dangers could reach a high order of magnitude."⁽³⁾

Turning to more esoteric aspects of society, the development of Artificial Intelligence (AI), for instance, is anticipated as having a very important impact on the sciences. Artificial Intelligence will influence the sciences in their general philosophical approach as well as in

(1) A. King, "For Better and for Worse: The Benefits and Risk of Information Technology," Conference on Information Society, North-Holland Publishing Company, Amsterdam, New York, Oxford, 1982, p. 41-42.

(2) Ibid., p. 43.

(3) Ibid.

their specific theoretical content, says Margaret A. Boden, who is employed with the Cognitive Studies Programme in the School of Social Sciences, University of Sussex, Brighton, United Kingdom. She says, psychology and, to a lesser degree, biology have already been affected by computer analysis. And, contrary to what most people assume, the results have been beneficial, e.g., references to 'mind' and 'mental processes' which were considered unscientific have been reinstated as a result of AI computation. Further, AI's influence is expected to be strong in the psychology of vision and language and it is likely that robotics will be melded with psychophysiology of movement to the benefit of the handicapped. She also foresees that as psychologists arrive at a better understanding of the organization of knowledge, their work might contribute to designing better and more useful computerized "expert systems."⁽¹⁾

Other social implications of AI will be far-reaching as well. First, there will be effects on individuals and institutions brought about by specific applications of AI, to "expert systems" for medical diagnoses, legal and financial advice, or educational help. Such programs, according to Boden, will not merely provide a service, but will likely change the social relations of the professions involved. For example, if general practitioners or nurses can use an AI program to aid in various aspects of patient-care, the social image of the specialist physician may deteriorate. Likewise, legal computer programs may undermine the status of lawyers and alter the nature of their work. With the mystique of the human experts lessened, the general public might hasten its reliance on computer programs. However, there is a distinct danger that the replacement of human professional advice by a reliance on ill-understood "expert systems" may prove inadequate for the purpose for some people.⁽²⁾

Finally, there are those who are concerned that computers and data banks and the whole informatics technology have outrun political control. Philippe Lemoine, head of the French National Commission on the

(1) M.A. Boden, "Impacts of Artificial Intelligence," Futures, No. 16, February 1984, p. 673.

(2) Ibid., p. 63.

Computerization of Society, underlines two aspects of the information and computer revolution that bother him. First, he says, the transparency of computers precipitates a situation that makes people unaware of them until one day they find that their whole lives depend upon them. This may prove devastating in times of crisis when the computer is "down" and people have to rely on themselves. Secondly, electronic data processing and telematics are "no more neutral as a technology than television is," i.e., it will have some effect!

Lemoine's fellow countryman, Simon Nora, of the Nora-Minc Report, similarly suggests that the structure of data banks themselves is in fact a tool for receiving culture. To make his point, Nora recalls what happened in the great period of accumulation of knowledge which began in the 18th century in Europe, particularly in France, with the publication of the Great Encyclopedia. As a consequence, its creators formed the structures and the mental and cultural categories on which Europe lived for two centuries, he contends. Nora sees a parallel between this period of history and the current development of informatics, and the information revolution that it is precipitating. He is particularly concerned about the power that emanates from big organizations and huge data banks. Specifically, he says:

On the level of history, on the level of memory, that each country has of its own culture, there has been an influence of categories controlling the classifications and the means of access to these stocks of culture. That seems to us particularly dangerous We're concerned about the fantastic growth of American data banks which are technologically advanced. The scale of their market is such that they have the ability to dominate. We want there to be in Europe, and particularly in France, some limit on this.

It isn't at all a question of a declaration of a cultural war on the Americans. They have a valuable culture in a certain number of areas. And it's not a question either of preventing access to this culture. What we want is some control over those affairs which relate to the fundamental cultural patrimony, without which a nation does not exist -- a binocular view which

permits us at least to have data banks corresponding to categories, to structures of our own culture We simply think that it's an area which belongs to us, and we should classify things at our own expense and by our own methods. I think that it's a problem that our Canadian friends should have very close to their hearts.(1)

PUBLIC POLICY

Unfortunately, most of the attention to date has been concentrated on the astounding wonders of an information era. Governments at all levels have been creating conditions for rapid technological development and giving little attention to the social implications of the new information infrastructure, according to Dr. Cordell. Such an obvious issue as employment and work in this new environment is only now being discussed in the context of an information society. If the issues that will accost society are not sensitively and adequately dealt with, the "casualties involved in adopting the new technologies could be great, and incalculable harm may be done to individuals and to Canadian society as a whole," he warns.(2)

More and more nations, however, are beginning to see information as a new resource and telematics or informatics, whichever word one chooses, as a major technological-sociological challenge whose depths are yet to be fathomed. In France, for instance, the Nora/Minc Report prescribed a unified national policy to utilize the new "technology of télématique." It apprised the French government of the reasons why its political system has to change to meet the new rules of economic life and the patterns of social life that will result from this new technology. The challenge was further compounded by what it saw as a threat to the independence of France by American domination of telecommunications and computers. Its authors concluded that "if France does not respond effectively to the

(1) CBC (1984), p. 37.

(2) Ibid., p. 100.

serious new challenges she faces, her internal tensions will deprive her of the ability to control her fate." (1)

Japan, in addition to increased research efforts to develop the fifth generation computer and an associated supercomputer has placed responsibility on the "knowledge-intensive industries to play a major role in the nation's future economic development." Apparently, knowledge-related industries are to "form the basis for long-term economic progress." Europe, no doubt influenced by the French desire for independence from the United States, has adopted a community-wide data communications network entitled "Euronet". The United States, meanwhile, has up to this point relied on its long tradition of looking to free enterprise augmented by close cooperation with the military to deliver the broad range of goods and services the nation desires and needs, including its telecommunications and computer facilities. This stance is currently being criticized, however, as making the country vulnerable to concerted attacks by firms and foreign governments that do not share the American confidence in free enterprise. Japan has already pulled even with the United States manufacture of computer hardware, although the Americans still have the lead in software. (2)

In Canada, the Clyne Report of 1978 echoed concerns regarding dependence on foreign telecommunications and computer products. In the way of advice it provided a checklist of proposed government actions to limit the operation of foreign information enterprises in Canada. Its recommendation with regard to government action on transborder data flow precipitated the amendment of the Canadian Bank Act. Among its provisions was the requirement that all bank data that might be needed by Canadian bank regulatory authorities be processed in Canada. Further, while banks could transmit data outside the country for processing, this was subject to review by the Inspector General of Banks.

(1) Nora and Minc (1980) - English translation, p. xv and 1.

(2) B.J. Wunder, "International Commerce in Telecommunications and Information Products," Columbia Journal of World Business, No. 18, Spring 1983, p. 64-66.

In 1982 the Science Council of Canada published a report urging the Canadian Government to meet the challenge of the rapidly approaching information revolution. This year Dr. Arthur Cordell, in a study produced under the aegis of the Council, corroborated the concerns voiced in the Science Council's 1982 report, as can be seen from his remarks extensively quoted above.

In 1984, in its Twenty-first Annual Review, the Economic Council of Canada, for the first time, dealt with the impact of informatics on the Canadian commercial and industrial scenes. Noting the cost reduction of the hardware and its increasing utilization in integrated automated office systems, the report indicated that Canada was fast becoming "an information-intensive society." In fact, it pointed out that the information economy now accounted for approximately one third of Canada's gross domestic product, with the financial and business sectors growing more sharply than education and public administration areas. It also noted that informatics and office automation technology had the potential of significantly changing the content of jobs, but concluded that there was not much likelihood of the current technological evolution developing into a revolution.⁽¹⁾

From the information above it would appear that a case could be made for the establishment of some type of national monitoring body to carry out research as well as apprise governments of the emerging problems and advise them accordingly. In the face of the undoubted impact that is being precipitated on the world community by the information revolution, one would think it prudent to look at the nature of the technology and its potential short-term consequences as well as its long-term cultural impact.

(1) Canada, Economic Council, Steering the Course, Twenty-first Annual Review, Minister of Supply and Services, Ottawa, 1984, p. 79-81.

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